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$$\cos t=\frac{1}{4m}\pm\frac{1}{4m}\sqrt{[(8m^2+1)]}=\frac{1}{4m}\{1\pm\sqrt{[(8m^2+1)]}\}.$$

$$\therefore t=\cos^{-1}\{\frac{1}{4m}[1\pm\sqrt{(8m^2+1)}]\}.$$

Also solved by G. B. M. Zerr, and H. C. Feemster.

GEOMETRY.

344. **Proposed by C. N. SCHMALL, 604 East 5th Street, New York.**

A tinsmith has a sheet of copper in the form of a rectangle, sides a and b. He desires to cut this into two pieces which will form a square when placed together. How can he do this?

I. **Solution by V. M. SPUNAR, M. and E. E., East Pittsburg, Pa.**

Assuming the base b of the rectangle to be divided into n and the other side a into $n-1$ equal parts. Then, cutting the whole figure by the broken line m, n, m', n', m'', n'', ..., pushing the left part one step down and shove it one step to the right, we will have for a square,

$$(n-1)x=ny.$$

Also, $a=(n-1)x$, and $b=ny$.

$$\therefore b:a=\left(\frac{n}{n-1}\right)^2.$$

As n must be a positive integer, the relation $b:a$ is *restricted* by the last equation. It is satisfied by the following series of numerical values.

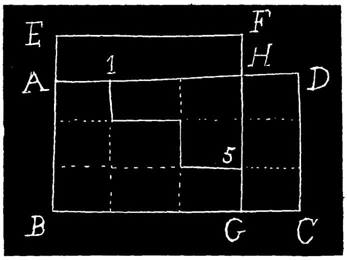
For $n=1, 2, 3, 4, 5, 6, 7, 8, 9, 10, ..., \infty$.

$b:a=\infty, 4, 2\frac{1}{4}, 1\frac{7}{9}, 1\frac{9}{16}, 1\frac{11}{25}, 1\frac{13}{36}, 1\frac{15}{49}, 1\frac{17}{64}, 1\frac{19}{81}, ..., 1$.

Hence, the required division is possible when the sides of the rectangle are in the ratio 4 : 1.

Also solvee by S. Lefsehetz.

II. **Solution by C. N. SCHMALL, 604 East 5th Street, New York.**



Let $ABCD$ be the given rectangular sheet of copper; $AB=a$, $BC=b$. Let us suppose a square (of paper) $EBGF$ to be constructed by the usual method of the mean-proportional. Then the rectangles $AHFE$ and $GCDH$ are equivalent, and their sides are therefore reciprocally proportional.

$\therefore AH:HD=GH:HF$, or $BG:GC=AB:AE$.

$$\text{or } \frac{BG}{GC}=\frac{AB}{AE}\ldots(1).$$

Hence, if BG be a multiple of GC then AB will be a multiple of AE. In that case divide BG by GC and AB by AE. Now cut along the line $A1$, 2 3, 4 5 to G and then bring 2 3, into coincidence with $A1$, and GC into coincidence with 4 5. Then the given rectangle has been transformed into a square. This problem is impossible if the ratios in equation (1) are not integers. In other words, if $AB=a$, and $BC=b$, $EB=\sqrt{(ab)}$, $EA=\sqrt{(ab)}-a$, $GC=b-\sqrt{(ab)}$, the equation (1) becomes

$$\frac{\sqrt{(ab)}}{b-\sqrt{(ab)}}=\frac{a}{\sqrt{(ab)}-a}=\text{an integer}\ldots(2),$$

and the desired section cannot be performed unless (2) be true.

Assume $\dfrac{a}{\sqrt{(ab)}-a}=\dfrac{\sqrt{a}}{\sqrt{(b)}-\sqrt{(a)}}=i$, an integer.

Then $\sqrt{(b)}=\sqrt{(a)}\,(1+\frac{1}{i})$, which is satisfied when $i=1$ only.

345. Proposed by LLOYD HOLSINGER, Bradley Polytechnic Institute, Peoria, Ill.

If a variable polygon move in such a way that its n sides turn severally round n fixed points O_1, O_2, ..., O_n while $n-1$ of its vertices slide, respectively, along $n-1$ fixed straight lines v_1, v_2, ..., v_{n-1}, then the last vertex will describe a conic; and the locus of the point of intersection of any pair of non-adjacent sides will also be a conic. Cremona's *Projective Geometry.*

No solution of this problem has been received.

346. Proposed by G. I. HOPKINS, M. A., Professor of Mathematics and Astronomy, High School, Manchester, N. H.

Prove the theorem for finding the lateral area of a frustum of a cone without the use of the theory of limits.

I. Solution by the PROPOSER.

The theorem relating to the lateral area of the frustum of a cone is given in most text books on Solid Geometry, and proved by the theorem of limits. The accompanying proof does not use limits. The lateral area of the frustum of a cone is equal to its slant height multiplied by one half the sum of the circumferences of its bases.

Let $BADE$ be the frustum of the cone OAD. Designate the radii of its bases by R and r, their circumferences by C and c. Also designate the lateral areas of the two cones by L and l, and their slant heights by S and s.

Then $S-s$ represents the slant height of the frustum, and $L-l$ its lateral area.